VIII. *On the primitive Crystals of Carbonate of Lime, Bitter-Spar, and Iron-Spar.* *By* William Hyde Wollaston, *M. D. Sec. R. S.*

Read February 13, 1812.

WHEN I formerly described to the Society a goniometer* upon a new construction for measuring the angles of crystals, I expressed an expectation that we should thereby be enabled to correct former observations made by means of less accurate instruments. I took occasion to mention one instance of inaccurate measurement in the primitive angle of the common carbonate of lime; and I have had the satisfaction to find the necessity of a correction, in that instance, confirmed by Mons. MALUS, and admitted by the Abbé HAÜY, in a work† published nearly at the same time.

It is by no means my design to detract in any degree from the merit of that justly celebrated crystallographer, to the surprising accuracy of whose measurements I could, in various instances, bear testimony. I hope, on the contrary, that in bringing forward two more observations similar to the preceding, and intimately connected with it, I shall offer what will not only appear interesting to crystallographers in general, but will be peculiarly gratifying to the Abbé HAÜY.

In his Traité de Minéralogie, and again more recently in his Tableau Comparatif, the same primitive form is assigned

* Phil. Trans. 1809.

† Tableau Comparatif des resultats de la Crystallographie et de l'Analyse Chimique.

to three substances very different in their composition, to carbonate of lime, to magnesian carbonate of lime (or bitter-spar) and to carbonate of iron.

It has been objected to Mons. HAÜY, that according to his method identity of form should be accompanied by identity of composition, unless the form were one of the common regular solids. For though in that case any geometrician would readily admit it to be very probable, that many different substances might concur in assuming the same form of cube, of octohedron, or of dodecahedron, &c. there does not appear a corresponding probability that any two dissimilar substances would assume the same form of a particular rhomboid of 105° and a few minutes, to which no such geometric regularity or peculiar simplicity can be ascribed.

But though so accurate a correspondence, as has been hitherto supposed to exist in the measures of the three carbonates above-mentioned, might be justly considered as highly improbable, no degree of improbability whatever attaches to the supposition, that their angles approach each other by some difference, so small as hitherto to have escaped detection. And this in fact I find to be the case.

Since the angles observable in *fractures* of crystalline substances are subject to vary a little at different surfaces, and even in different parts of the same surface (as is evident from the confused image seen by reflection from them), I shall not at present undertake to determine the angles of these bodies to less than five minutes of a degree. This, indeed, is the smallest division of the goniometer that I usually employ, as I purposely decline giving so much time to these inquiries, as would be requisite for attempting to arrive at greater precision.

The most accurate determination of the angle of carbonate of lime is probably that of Mons. MALUS, who measured it by means of a repeating circle, and found it to be 105° 5′. And this, indeed, is the result to which I formerly came by a different method.* If it differ in any respect from this quantity, I am inclined to think that it will more likely be found to be deficient by a few minutes, than to exceed the measure here assigned; and accordingly to differ still more widely from those angles which I am about to mention.

In the magnesian carbonate of lime, or bitter-spar, the primitive form is well known to be a regular rhomboid, as well as that of carbonate of lime, and so nearly resembling it, as to have been hitherto supposed the same. I find, however, a difference of 1° 10′ in the measures of these crystals; for that of the magnesian carbonate is full 106¼°, as I have observed with uniformity in at least five different specimens of this substance obtained from situations very distant from each other.

The primitive angle of iron-spar is still more remote from that of the carbonate of lime, which it exceeds by nearly two degrees. I have examined various specimens of this substance, some pure white, others brown, some transparent, others opake. That which gives the most distinct image by reflection is of a brownish hue, with the semi-transparency of horn. It was obtained from a tin mine, called Maudlin Mine, near Lostwithiel in Cornwall. By repeated measurement of small fragments of this specimen, the angle appears to be so nearly 107°, that I cannot form any judgment whether in perfect crystals it will prove to be greater or less than that angle.

In this instance the carbonate of iron is nearly pure, and so

* Phil. Trans. 1802, p. 385.

perfectly free from carbonate of lime, as to render it highly probable that in other specimens, having the same angle, but containing also carbonate of lime or other ingredients intermixed, the form is really dependent on the carbonate of iron alone.

It appears, however, not unlikely that when substances, which agree so nearly in their primitive angle, are intermixed in certain proportions, they may each exert their power; and may occasion that confused appearance of crystallization with curved surfaces, known by the name of pearl-spar. I cannot say that I have made any accurate comparative analyses which may be adduced in support of the hypothesis, that mixtures are more subject to curvature than pure chemical compounds; but it is very evident, from the numerous analyses that have been made of iron-spar by other chemists, how extremely variable they are in their composition, and consequently how probable it is, that the greater part of them are to be regarded as mixtures; although it be also possible, that there may exist a triple carbonate of lime and iron as a strict chemical compound.

It seems not unlikely, that there may hereafter be found some carbonate allied to the preceding, which may owe its form to the presence of manganese; but notwithstanding the liberality which happily prevails in general among those who have it in their power to assist in such inquiries, I have not had the good fortune to meet with any such compound; and I am unwilling, merely in the hope of making such an addition, any longer to defer communicating an observation, which I hope will be of real utility in the discrimination of bodies that differ so essentially in their composition.